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structure of *Phascum subulatum*, but is so different in the stalked, elongated capsule, and the campanulate calyptra, that I dedicate it to my friend Herr Sporleder, etc."

It will be seen from the above remarks that Hampe was laboring under a mistake when he contrasted the calyptras of *B. flexuosa* with his *Sporledera Beyrichiana*, due to the fact that there is a mixture in Schwægrichen's Supplement, in the figure of the calyptra of *Phascum flexuosum*. Furthermore, a part of the type specimen from Hampe's Herbarium is preserved in Sullivan's Herbarium, and although they are immature, yet there is no doubt that it is a species of *Bruchia*, closely allied to the type species of the genus *B. flexuosa*, which antedates *S. Beyrichiana* by fourteen years.

The other species, *B. palustris* (Br. & Sch.) C. Müll., which, according to Müller (Syn. Musc. 1: 19, 1848), was admitted to this genus by Hampe (in litt.), and is so maintained by Limpricht (Rab. Kryptfl. 4: 204), must either be given a new generic name, or merged into *Bruchia*. The absence of the characteristic neck of *Bruchia* would seem to justify its generic rank; the lobate calyptra throws it out of *Pleuridium*, where Schimper placed it, though it is more liable to be mistaken for *P. subulatum* than for any species of *Bruchia*.

The original description of *Sporledera*, calling as it does, for a "large" calyptra, enclosing the capsule, makes it doubtful whether *Phascum palustre* can be included in this genus. Furthermore, it is a question whether a genus can be maintained for a species subsequently referred to it, when the original species and characters of the genus are referable to an older genus.

### Notes on some Exoasceæ of the United States.\*

BY GEORGE F. ATKINSON.

Material has accumulated from several years collecting which led me to begin the preparation of a paper on the prunicolous species of the *Exoasceæ* of the United States. Unexpectedly a

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\* I wish to acknowledge my indebtedness to Prof. Thomas Meehan, Prof. L. H. Pammel, Mr. J. B. Ellis, Prof. A. B. Seymour and Mrs. Flora W. Patterson, for favors mostly in the communication of material of some of the prunicolous species.

number of new species came to light when the critical study was made. This paper, which is now in press, will present numerous illustrations both of the deformities caused by these fungi in their hosts and of the structure of the various species of the parasites. It has seemed advisable to present in the BULLETIN some notes on these species, with descriptions of those which are considered new. I anticipate there will be some criticism of the disposition which I have made of certain forms, and I beg those who feel thus disposed to withhold a final judgment until the illustrated paper shall appear. There will be given a fuller discussion of the grounds for this arrangement, as well as careful camera lucida drawings, all to the same scale, so that a better defense of my position will then appear than could possibly be given in these notes.

EXOASCUS DEFORMANS (Berk.) Fuckel.

In the arrangement which I have proposed of the forms occurring on leaves this species occurs only on the leaves and shoots of the peach, *Amygdalus Persica*.

EXOASCUS PRUNI Fuckel.

*Exoascus Pruni*, as I understand it from the material at hand, occurs only on the fruit of *Prunus domestica* L. in the United States.

EXOASCUS INSITITIÆ Sadebeck.

To this species I would refer the specimens collected by Seymour at Temple, N. H., June 16, 1888, on the leaves of *Prunus Pennsylvanica* L. See Seymour and Earle, Economic Fungi, no. 15. The specimens to which I have had access show several small twigs curved to one side growing from the end of a larger one. The twig has very much the appearance of a small "Witches' Broom." The young twigs are pale and slender, the leaves slightly and finely folded or wrinkled, and the under surface is greyish-white in color from the asci. These characters, together with the size of the asci and the relative size of the asci and stalk-cells agree, it seems to me, with Sadebeck's\* species as he describes it on *Prunus insititia* L. and *P. domestica* L.

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\* Unters. u. d. Pilzgattung *Exoascus*, etc. Ab. a. d. Jahrb. d. Hamb. Wiss. Anst., 113: 1884.

Kritische Unters. u. d. durch *Taphrina*-Arten, etc. Ibid, 8: 27. 1891.

Die parasiten Exoascen. Ibid, 10: 2, 48. 1893.

## EXOASCUS CERASI (Fuckel) Sadebeck.

To this species I refer the specimens collected at Germantown, Pa., on "escaped cherry trees," by Prof. Meehan, and distributed as *Exoascus Wiesneri* Rathay, in Ellis' N. A. F. no. 2286. It forms "Witches' Brooms" and agrees in all essential characters with Sadebeck's characterization of this species which occurs on *Prunus Avium* L. and *P. Cerasus* L. in Europe. Prof. Meehan writes me that the cherry trees from which the specimens were gathered are *P. Avium* L.

## EXOASCUS COMMUNIS Sadebeck.

This occurs on the fruit of *Prunus maritima* Wang., forming "pockets" (Dartmouth, Mass.), *P. pumila* L., *P. nigra* Aiton (Alma, Mich.), and *P. Americana* Marshall (Seymour and Earle, Economic Fungi, no. 13, Madison, Wis.). It differs slightly from *E. Pruni* Fuckel, the asci being quite regularly clavate and the stalk-cells proportionately more slender, pointed below, and according to Sadebeck (l. c.) they do not intrude between the cells of the epidermis.

## EXOASCUS FARLOWII Sadebeck.

This deforms the fruit and floral envelopes of *Prunus serotina* L. According to Sadebeck (l. c.), the asci are not crowded but separated from each other. In the examination of a large amount of material from different parts of the United States, I have rarely found this to be the case. There are, however, other characters mentioned by Sadebeck which make it a good species.

## EXOASCUS CONFUSUS n. sp.

This name I have proposed for the species which deforms the fruit and floral envelopes of *Prunus Virginiana* L. A study of the structure of the fungus has convinced me that it is specifically distinct from *E. Pruni* on *P. domestica*. The asci on the fruit of *P. domestica* I have found, in the specimens examined, constantly more slender, and the stalk-cells also more slender proportionately than those on the fruit of *P. Virginiana*. These are 30-45  $\mu$  long by 8-12  $\mu$  in diameter. The stalk-cells are 15-30  $\mu$  long by 6-10  $\mu$  in diameter; they are nearly or quite the same diameter as the asci and are proportionately longer than those of *E. Pruni* on *P. domestica*. The proportion between these

two structures is more nearly the same as that existing in the case of the *E. Farlowii* Sadeb. on *P. serotina*, while the asci and stalk-cells of *E. Pruni* Fuckel on *P. domestica* are more nearly related to those of *Exoascus communis* Sadeb. on *P. maritima*, *pumila*, *nigra*, etc. This is what we would naturally expect since *P. Virginiana* and *P. serotina* belong to a different section of the genus *Prunus* than do *P. domestica*, etc. The physiological influence of the fungus on the fruit of *P. Virginiana* is also different from that of *E. Pruni* on *P. domestica*. The floral envelopes are constantly subject to hypertrophy and also bear asci, in which respect it also agrees with that on *P. serotina* and differs from that on *P. domestica*.

*EXOASCUS LONGIPES* n. sp.

This species has been found at Danby, near Ithaca, N. Y., producing "pockets" in the fruit of *Prunus Americana* Marshall. It is related to the *E. Pruni* and *E. communis* types, but differs in the long stalk-cells which are strongly intruded between the cells of the epidermis. The asci are 30–40  $\mu$  long and 7–10  $\mu$  in diameter. The stalk-cells are 25–35  $\mu$  high by 3–5  $\mu$  in diameter, being usually much narrower below. The lower ends of the cells of the hymenium begin quite early to intrude themselves between the epidermal cells.

*EXOASCUS DECIPIENS* n. sp.

This has been collected at Ætna and Danby, N. Y., on the leaves of *Prunus Americana* Marshall. It sometimes produces isolated, open, shallow pockets in the leaves, but more frequently attacks a large part of the bases of expanded leaves, where it throws the leaf into a series of fine, irregular folds. On the lower side of the leaf the asci are scattered or rather loosely aggregated in groups. The asci are 20–40  $\mu$  long by 7–10  $\mu$  in diameter. The stalk-cells are 6–13  $\mu$  high by 7–12  $\mu$  in diameter, and are usually rounded below. The spores are oval or broadly elliptical, and 3–4  $\mu$  in diameter. Conidia are frequently developed, while still in the ascus, by budding.

The shoots are also attacked, and sometimes enlarged, though I never have seen the asci on them. Sometimes the young leaves are attacked and killed without the development of any asci and

become black and crisp, and the bases of the larger leaves which bore the asci also become blackened. This also extends into the ends of the affected shoots.

*EXOASCUS DECIPIENS SUPERFICIALIS* n. var.

The half developed fruits of *Prunus Americana* Marshall are sometimes affected on the surface with a species of *Exoascus* which may prove to be a distinct one, but for the present it seems best to place it as a variety of this species, especially since the specimens were found on one of the same trees, though not in close proximity to the affected leaves. While the mycelium is found rather scantily to some depth in the tissues of the fruit, the stone appears to be normally developed, or at least not absent. The asci are 25–30  $\mu$  long by 8–11  $\mu$  in diameter, and the stalk cells are very short. Farther study is necessary to determine the limits of the characters.

*EXOASCUS MIRABILIS* n. sp.

The distorted young buds and shoots of *Prunus angustifolia* Marshall, the Chickasaw plum (*P. Chicasa* Michx.), I have used as the type of this species. It occurs in the Southern States and some of the Western. I have observed it for three years (1890–92) in Alabama (and in S. C. in 1889),\* where it sometimes produces serious injury both to wild and cultivated varieties. The buds become transformed into a large clavate or ovate mass of tissues, which is usually hollow within and much resembles the tissues of the plum “pockets,” caused by *E. Pruni*. The surface of these hypertrophied buds is covered with the asci. The asci are slightly clavate, rounded or truncate at the free ends, are 25–45  $\mu$  long by 8–10  $\mu$  in diameter. The stalk-cells are 10–18  $\mu$  high by 5–8  $\mu$  in diameter, are usually rounded or truncate at the base, and do not intrude between the cells of the epidermis. The spores are quite regularly elliptical. To this species I also would refer specimens from Iowa, communicated by Prof. Pammel, on the buds of *Prunus hortulana* L. H. Bailey, a closely related species, and upon *P. Americana* from the same place.

*EXOASCUS MIRABILIS TORTILIS* n. var.

On the fruits of the Chickasaw plum, *P. angustifolia* Marshall,

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\* Erwin Smith reports it from Maryland and Georgia, Journ. Myc. 6: 108.

in the Southern States, the fruit is frequently distorted by a fungus which I take to be of the same species as the one on the buds. All the essential characters are the same, but the asci and stalk-cells seem to be on the average a little longer, probably due to the greater amount of nourishment which the fruit provides. In the specimens examined the entire fruit is not affected as in the case of *E. Pruni* and related species, but only one side, sometimes only a small portion of it. Only one side then is hypertrophied and may appear as a large wart, or the fruit may be curved and variously twisted. Rarely does it form a "pocket." In order to avoid possible confusion, I have thought it well to distinguish this fruticolous form as a variety.

The fruits of cultivated varieties of *P. Americana*, in Iowa, appear to be somewhat similarly distorted, and with the examination I have made, they, as well as the asci, etc., seem to be more nearly related to this form than to *E. communis* Sadebeck, but I should prefer to reserve a decision until further observation is at hand as to the relation of these fruits to the deformed buds of *P. Americana*.

*EXOASCUS RHIZIPES* n. sp.

This interesting species I have found upon the Japan plum, *Prunus triflora* Roxburgh. I collected it at Auburn, Ala., in May, 1892. It deforms the buds and fruit very much as *E. mirabilis* Atkinson, does those of *P. angustifolia*, but the structure of the fungus is quite different. It is more closely related to the *E. longipes* Atkinson on the fruit of *P. Americana* Marshall. From this it differs in the still longer stalk-cells which intrude farther between the cells of the epidermis, and especially in the possession of numerous rhizoids which grow not only from the stalk-cells, but also from the lower portion of the asci. The form of the plant on the fruit I have used as the type of the species. Here the asci are 30–40  $\mu$  long by 8–10  $\mu$  in diameter. The stalk-cells are 25–40  $\mu$  long and 3–5  $\mu$  in diameter, tapering much below. In very thin sections the lower part of the hymenium, from the numerous rhizoids which branch off at all depths, appears as a cellular tissue from which the asci arise.

The form on the bud is similar, but the rhizoids are not as long nor as numerous, but still much more so than in *E. longipes*. These

characters with the different physiological effect produced on the host separate it from that species.

EXOASCUS VARIUS n. sp.

As the type of this species I have used the *Exoascus* on the leaves of *Prunus serotina* L., which I have collected very abundantly in Alabama. It is usually referred to *E. deformans*. It appears to me to be clearly distinct from that species, and to approach nearer in the relative proportion of the stalk-cells and asci to the species on the fruit of *P. serotina*, viz. *E. Farlowii* Sadeb. The asci are 20–27  $\mu$  long by 8–10  $\mu$  in diameter, and the stalk-cells 12–17  $\mu$  high by 8–10  $\mu$  in diameter. These measurements are taken from specimens which represent the longest stalk-cells. There are great variations and frequently the stalk-cells are only one-fourth as long as the entire fruit body, instead of one-third as long. The asci occur on both sides of the leaves.

The fungus quite frequently deforms the same shoots on which the affected leaves are borne, but there is no tendency, so far as I have observed, to form "Witches' Brooms." Specimens of this were distributed by Seymour and Earle, Economic Fungi, no. 128, as *Taphrina deformans* (B.) Tul. What I take to be the same was distributed in Ellis' N. A. F. no. 2285 b. as *Taphrina Prun* (Fuckel), from Missouri. I have specimens from Smyrna, Del., communicated by Ellis, and it occurs in other places.

Rather scanty specimens on the leaves of *Prunus demissa* Walp. from Ute Pass, Colorado, ex herb. Trelease, communicated by Prof. Pammel, I have referred to this species with some doubt.

EXOASCUS CECIDOMOPHILUS n. sp.

This is another very interesting species which I collected near Ætna, N. Y., July 6, 1894, and other places. It occurs on galls formed by the larvæ of some cecidomid on the fruit of *Prunus Virginiana* L. The greater part of the hypertrophy is controlled by the larvæ of the cecidomid. The fungus is mostly superficial, the mycelium being scanty and not penetrating very deep. The deformed fruits are two to four times longer than the normal ones and slightly broader. The ends are rounded, the middle a little inflated, a slight strong constriction near the base which appears to flare out, and in doing so, gradually appears to break away



from the receptacle at one or more points and thus opens the gall. The tissue of the gall is quite hard as compared with that of the hypertrophied fruits caused by *E. Pruni* and related species. The hollow interior is comparatively smooth, and in the apex of this several of the larvæ of the cecidomid are bunched.

The fungus appears only to attack a portion of the surface. These portions are then still more swollen and cause the gall to be quite strongly curved. The asci are cylindrical or rarely clavate. They are 30–40  $\mu$  long by 6–10  $\mu$  in diameter. The stalk-cells are very broad and rounded below, being 6–10  $\mu$  high by 10–15  $\mu$  in diameter.

Further study is needed to determine just the relation which the cecidomid bears to the fungus. At the present writing I do not think that the fungus occurs on all of the fruits which are deformed by the insect.

Besides these prunicolous species of *Exoasceæ* two others worthy of note have been collected by myself in the Southern States. One of these proves to be undescribed.

#### EXOASCUS AUSTRALIS n. sp.

This was collected at Auburn, Ala., April 30, 1892, on the leaves of *Carpinus Americana* Michx. It attacks only the leaves and does not deform "Witches' Brooms," as does *Exoascus Carpinii* Rostrup, upon *Carpinus Betulus* in Europe. It is in other respects very different.

Usually nearly the entire leaf is affected and strongly arched upward, giving it a rude, boat-shaped appearance. There are also separate archings between the larger lateral veins which thus throw the surface into a series of strong folds. The upper surface of the leaf is bright red until it begins to die, when it turns brown, then black, then falls away.

The asci are borne only upon the upper surface, in so far as I have observed. They stand closely crowded together. They are mostly cylindrical, and 50  $\mu$  long, but sometimes vary from 30–60  $\mu$  long. The usual diameter is from 7–8  $\mu$ , but sometimes they become even 10  $\mu$ , where they are not very much crowded. The ends are truncate. They lack a stalk-cell, but frequently the base is more or less abruptly narrowed into a

short stalk-like base. The spores are round and measure 4-5  $\mu$  in diameter. The mycelium is subcuticular only, not penetrating into the tissues of the leaf.

*TAPHRINA AUREA* (Persoon) Fries.

This species was collected at Columbia, S. C., May, 1889, on the leaves of *Populus monilifera* Aiton. It forms rounded, rather deep, open pockets which arch upwards, the asci being on the concave or under side of the spots. The asci are of the slender kind in the specimens examined, with long narrow stalk-cells, which penetrate far between the epidermal cells. According to Sadebeck this species has hitherto been reported on *P. monilifera* only from Denmark. It is also, I believe, the first recorded occurrence of this species in North America, the specimens which have been heretofore reported as belonging to this species in this country occur on the fertile aments of species of *Populus*, which is entirely different. These specimens on the fertile aments of several species of *Populus* (*tremuloides*, *Fremontii*, *grandidentata*), have been referred by Farlow to *Taphrina rhizophora* Johanson. I have had an opportunity of examining specimens from the fertile aments of *Populus tremuloides* Michx. collected at Ithaca, N. Y., by R. H. Pettit, May 13, 1891. They are certainly *Taphrina rhizophora* Johanson, the asci lacking the stalk-cells, and the narrowed base penetrating 30-40  $\mu$  in the tissue of the hypertrophied ovary.

### Botanical Notes.

*The Systematic Botany of North America* has been inaugurated by the distribution of sample pages taken from the manuscript of the Hepaticæ, prepared by Professor Underwood. The board of editors announce the following parts for 1895, but their sequence may be somewhat changed:

Vol. 5: Parts 1 and 2, Pyrenomycetes by Messrs. J. B. Ellis and B. M. Everhart; Vol. 9: Part 1, Hepaticæ by Prof. L. M. Underwood; Vol. 10: Part 1, Typhaceæ, Sparganiaceæ, Naiadaceæ, Juncaginaceæ, Alismaceæ, Hydrocharitaceæ by the late Dr. Thomas Morong; Vol. 11: Parts 1 and 2, Cyperacæ by Prof. N. L. Britton and Prof. L. H. Bailey.